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PATENT

Sir:
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For: **METHOD AND SYSTEM FOR AUTOMATED MONITORING OF QUALITY OF SERVICE OF DIGITAL VIDEO MATERIAL DISTRIBUTION AND PLAY-OUT**

Enclosed with the Patent Application are:

- ☒ One (1) sheet of Drawings
☒ Declaration and Power of Attorney
☒ Assignment and Recordation Form
☐ Information Disclosure Statement (PTO Form 1449)
☐ A certified copy of a _____ application
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The filing fee has been calculated as shown below:

	(Col. 1)	(Col. 2)
FOR:	NO. FILED	NO. EXTRA
BASIC FEE		
TOTAL CLAIMS		
29 - 20	=	9
INDEP. CLAIMS		
3 - 3	=	0
MULTIPLE DEPENDENT CLAIM PRESENTED		

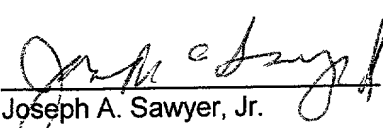
*If the difference in Col. 1 is less than "0", enter "0" in Col. 2

☒ The Commissioner is hereby authorized to charge Deposit Account No. 09-0452 (IBM Corporation) the amount of **\$852.00** for payment of application filing fees.

LARGE ENTITY		
RATE		FEE
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x 18	=	\$ 162.00
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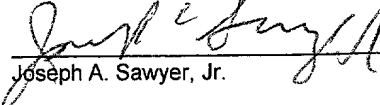
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FOR

METHOD AND SYSTEM FOR AUTOMATED MONITORING OF QUALITY OF SERVICE OF DIGITAL VIDEO MATERIAL DISTRIBUTION AND PLAY-OUT

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METHOD AND SYSTEM FOR AUTOMATED MONITORING OF QUALITY OF SERVICE OF DIGITAL VIDEO MATERIAL DISTRIBUTION AND PLAY-OUT

FIELD OF THE INVENTION

The present invention relates to a method for measuring the quality of service and the duration of a given digital video program that has been transmitted, including in the compressed domain (e.g., MPEG-2 PES level).

BACKGROUND OF THE INVENTION

When distributing video material over cable channels, satellite, or air waves, it is necessary to measure the quality of service of the distribution system. Quality of service of distribution is measured according to whether the video material was delivered in whole and on time and to the proper location/audience. For example, advertisers that play video material over television or cable channels need to verify that their shows, commercials or spots actually play to air. Companies also need to monitor and track video (digital or analog) files as well as perform certain tasks based on the usage of the video file (e.g., billing royalties based on video use). Today, there are a few methods to perform this validation.

In current distribution environments, i.e., analog environments, monitoring distribution of video material, whether compressed (digital) or uncompressed (analog), for quality of service relies on techniques that utilize significant manual human activities. These methods include:

1. Taping the day's programs and then having a person review the tape to see that the material played.

2. Using industry groups (e.g., Nielsen) that have employees literally watch TV to see that the material plays. These people enter the information on paper. This information is then consolidated and reports are sent back to the advertisers.

3. Using video detectors that can detect loss of signal, but can't typically tell if the video is playing correctly or not.

4. Tracking the location and path that files are distributed.

These approaches are not very reliable and are time consuming. Furthermore, these approaches require a long time between validation and correlation at the program source/ad agency.

Accordingly, a need exists for a more efficient and automated manner of verifying the quality of service of video material being distributed and played, particularly in the compressed domain. The present invention addresses such a need.

SUMMARY OF THE INVENTION

The present invention provides method and system aspects for automated monitoring of quality of service of digital video material being distributed and played. The aspects include embedding a signature in each frame of the digital video material by a program source device control. Computation of play-out statistics for the digital video material based on the signature by a program play-out device control is also included.

Through the present invention, determining statistics on a particular video program occurs in a manner that avoids intensive manual human monitoring and provides a more efficient and automatic ability to achieve quality of service measurements. The present invention utilizes technology to embed hidden data into a video or associate data with the

video file, and provides the ability to take correlated hidden data and video images together that an application can then process to do applications such as billing, quality of service measurements, rights management, and external device control. These and other advantages of the aspects of the present invention will be more fully understood in conjunction with following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a block diagram of a digital video distribution system in accordance with the present invention.

Figure 2 illustrates a block flow diagram of automated quality of service monitoring in the system of Fig. 1 in accordance with the present invention.

DETAILED DESCRIPTION

The present invention relates to method and system aspects for automated monitoring of the quality of service of digital video material distribution and play-out. The following description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment and the generic principles and features described herein will be readily apparent to those skilled in the art. Thus, the present invention is not intended to be limited to the embodiment shown but is to be accorded the widest scope consistent with the principles and features described herein.

Figures 1 and 2 present a block system diagram and a block flow diagram, respectively, of a preferred embodiment of the present invention for automated monitoring of quality of

service of digital video material distribution and play-out. Digital video material is provided from a video program source 10 for inclusion with a program feed, e.g., a satellite program feed, a cable feed, or a terrestrial feed. The digital video source material is encoded (e.g., at a central location associated with the program source 10) with hidden data (step 100).

5 Preferably, the hidden data includes a signature computed by a chosen hashing function, e.g., CRC for each frame belonging to the digital program material. By way of example, a digital advertisement or Ad, that lasts 30 seconds and is played at 30 fps (frames per second) contains 900 frames; for each frame, an individual signature is computed, thus resulting in 900 signatures for the Ad. Preferably, a header of the signature includes a key identifier that will enable detection of the presence of the signature in the frame, as is well appreciated by those skilled in the art. Further, the hashing function used to compute the signature preferably provides a very small probability of a false match ($<0.01\%$).

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captures the meta-stream in order to initiate computation of the signature for the incoming digital video data (step 110).

Because of the high bit rate requirements for the distribution of high quality video/audio, a compression scheme can be used to significantly reduce the bandwidth requirements (e.g. MPEG-2 can achieve 1:100 compression ratio). Additionally the usage of high efficient modulation schemes (e.g., QAM, QPSK, VSB) allows for several compressed video streams to be multiplexed over the same analog channel. In the MPEG-2 standard, a built-in multiplexing scheme (Transport Stream) provides the facilities for such multiplexing, where each video stream is packetized (into 188 byte packets) and a range of PID (packet identifiers) are assigned for each program, as is well understood by those skilled in the art.

The preferred embodiment uses a MPEG-2 demultiplexer that is capable of receiving (de-multiplexing) all the individual programs that are multiplexed over the MPEG-2 Transport Stream. A real time parser removes the transport layer (Packet header, adaptation field, etc.), extracting the video PES layer.

A signature engine in the video play-out device 20 parses the video PES layer (removing PES headers) and computes signatures utilizing the video payload, so that for each frame (I, B, and P) a signature is computed. Appropriately, the hashing function used to compute the signature at the play-out device 20 is the same as the one used in the source device 10. Once the signature is computed, it is stored in a local storage associated for each individual program.

The meta-stream is then utilized to determine statistics related to the play-out of the digital video data (step 120). When the video data is received by the play-out device, the hidden data is detected on a minimum of a frame basis. By detecting the hidden data, the

number of frames there were correctly decoded is computed, and therefore, with a very high probability, the video data is considered to have played-out correctly (i.e., been a visible image). Further, with the detection of the hidden data at the start and end of the video data, validation that the entire video data actually played-out results. By way of example, the Ads scheduler information is utilized to trigger a matching engine, i.e., to trigger the start of a comparison between the incoming signatures of the digital video in the hidden data with the ones stored. Thus, computation of the statistics includes computing a number of frames that have the correct signature, the time the video material was effectively played, the video material duration, etc. The statistics determined are preferably stored on a non-volatile local storage of the play-out device 20. The play-out play-out statistics can then be automatically analyzed through desired application programming for quality of service measurements (step 130). Preferably, the statistics collected are transmitted back to the program source 10 using an encryption scheme in keeping with the one used by the program source 10 for analysis.

Through the present invention, determining statistics on a particular video program occurs in a manner that avoids intensive manual human monitoring and provides a more efficient and automatic ability to achieve quality of service measurements. The present invention utilizes technology to embed hidden data into a video or associate data with the video file, and provides the ability to take correlated hidden data and video images together that an application can then process to do applications such as billing, quality of service measurements, rights management, and external device control. The hidden data can be put into the video image side bands, user data or other location that is transparent to the video image.

CLAIMS

What is claimed is:

- 1 1. A method for automated monitoring of quality of service of digital video material
2 being distributed and played, the method comprising:
3 embedding a signature in each frame of the digital video material by a program source
4 device control; and
5 computing play-out statistics for the digital video material based on the signature by a
6 program play-out device control.

2 2. The method of claim 1 wherein the step of embedding further comprises utilizing a
3 hashing algorithm to produce the signature for each frame in the digital video material during
encoding of the digital video material.

1 3. The method of claim 2 further comprising providing a key identifier in a header of the
2 signature and identifying inclusion of the signature based on the key identifier.

1 4. The method of claim 2 wherein embedding further comprises creating a meta-stream
2 for the digital video material and encrypting the meta-stream.

1 5. The method of claim 4 wherein the meta-stream further comprises a header session.

1 6. The method of claim 5 wherein the header session further comprises an identifier, a
2 length, and a time of play-out of the digital video material.

1 7. The method of claim 4 wherein the step of computing statistics further comprises
2 capturing the meta-stream and computing the signature for an incoming stream of digital video
3 material.

1 8. The method of claim 7 further comprising utilizing the signature of the meta-stream to
2 trigger comparison with the computed signature of the incoming stream of digital video material.

1 9. The method of claim 8 further comprising computing a number of frames having a
2 matching signature to the computed signature, identifying a time of play-out for the video stream,
3 and determining a duration of the digital video material played-out.

1 10. The method of claim 9 further comprising storing the play-out statistics on a local
2 storage device for the play-out device control.

1 11. The method of claim 10 further comprising transmitting the play-out statistics back
2 for the program source device control for quality of service measurements.

1 12. The method of claim 1 wherein the digital video material further comprises a digital
2 advertisement.

1 13. A system for automated monitoring of quality of service of digital video material
2 being distributed and played, the system comprising:

3 a program source of viewing program data, the program source embedding a signature in
4 each frame of digital video material within the viewing program data;

5 a play-out device for receiving the viewing program data and computing play-out
6 statistics for the digital video material based on the signature; and

7 a display device coupled to the play-out device for displaying video output of the viewing
8 program data from the play-out device.

14. The system of claim 13 wherein the viewing program data further comprises a cable
station program feed.

15. The system of claim 13 wherein the viewing program data further comprises a
satellite program feed.

16. The system of claim 13 wherein the viewing program data further comprises an air
wave program feed.

17. The system of claim 13 wherein the play-out device further comprises a set-top cable
box.

18. The system of claim 13 wherein the play-out device further comprises a cable head-
end.

1 19. The system of claim 13 wherein the play-out device further comprises a computer.

1 20. The system of claim 13 wherein the digital video material further comprises a digital
2 advertisement.

1 21. The system of claim 13 wherein the program source further provides the signature in
2 a meta-stream, the meta-stream including an identifier for the digital video material, a length of
3 the digital video material, and a time for play-out of the digital video material.

4 22. The system of claim 21 wherein the play-out device further computes play-out
statistics by capturing the meta-stream, computing a signature for the digital video material, and
comparing the computed signature to the provided signature.

5 23. The system of claim 22 wherein the video play-out device further computes statistics
6 by computing a number of frames in the digital video material having a match condition with the
signature, identifying a time of play-out of the digital video material, and determining a duration
of the digital video material actually played-out.

1 24. The system of claim 23 wherein the video play-out device stores the play-out
2 statistics in a local storage and transmits the play-out statistics to the program source, wherein the
3 program source measures quality of service for the digital video material from automated analysis
4 of the play-out statistics.

1 25. A method for achieving automated monitoring of quality of service of digital
2 video material play-out in a video distribution and display system, the method comprising:
3 embedding video source material at a program source with hidden data and a meta-stream
4 for uniquely marking a digital advertisement with the video source material;
5 isolating the meta-stream and the digital advertisement from the video source material in
6 a program play-out device; and
7 utilizing the meta-stream in the program play-out device to determine play-out statistics
8 for the digital advertisement.

9 26. The method of claim 25 wherein the hidden data further comprises a signature
10 generated by a hashing algorithm for each frame of the digital advertisement.

11 27. The method of claim 25 wherein the meta-stream further includes an identifier for the
12 digital advertisement, a number of frames of the digital advertisement, and a time for play-out of
13 the digital advertisement.

14 28. The method of claim 27 wherein the play-out statistics further comprise a start-time
15 of play-out, a number of frames in the digital advertisement correctly decoded, and an end-time of
16 play-out of the digital advertisement.

[illegible]

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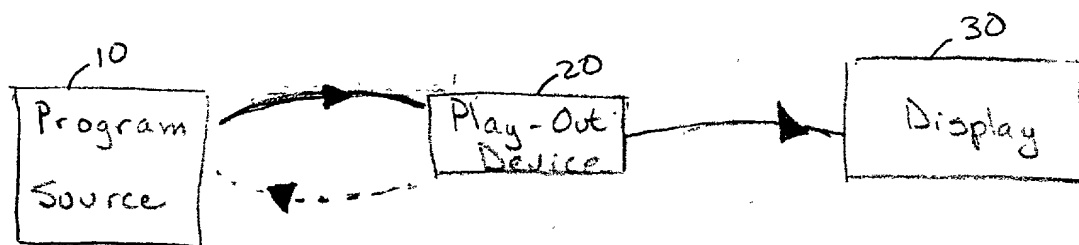


FIG. 1

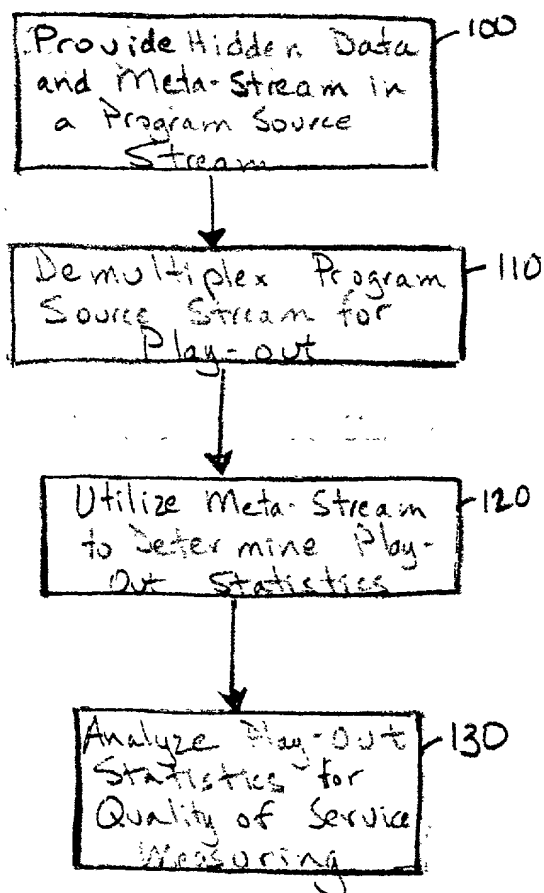


FIG. 2

DECLARATION AND POWER OF ATTORNEY FOR UTILITY PATENT APPLICATION

As a below named joint-inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name,

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**METHOD AND SYSTEM FOR AUTOMATED MONITORING OF QUALITY OF SERVICE
OF DIGITAL VIDEO MATERIAL DISTRIBUTION AND PLAY-OUT**

the specification of which

X is attached hereto.

___ was filed on _____

under Attorney's docket no.: _____

as Application Serial No.: _____

and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, Section 1.56 (a).

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119, of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

<u>Prior Foreign Application(s)</u>			<u>Priority Claimed</u>	
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____	_____	_____
(Number)	(Country)	(Day/Month/Year Filed)	Yes	No
_____	_____	_____	_____	_____

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, Section 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Serial No.)	(Filing Date)	(Status -- patented, pending, abandoned)
_____	_____	_____
(Application Serial No.)	(Filing Date)	(Status -- patented, pending, abandoned)
_____	_____	_____

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorneys and/or agents to prosecute this application and conduct all business in the United States Patent and Trademark Office connected therewith.

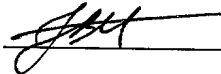
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Date: 06-14-2000

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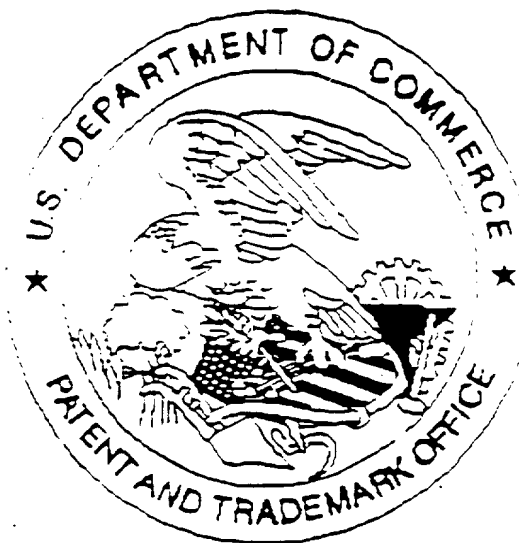
Country of Citizenship: **United States of America**

Post Office Address: **Same**

Signature of Inventor: Bob Lee Date: 5/3/00

Date: JUNE 18, 2000

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